

PCT

10/552612

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44bis)

|   |  |  |
|---|--|--|
| Applicant's or agent's file reference<br>15783 MdX  | FOR FURTHER ACTION   | See item 4 below   |
| International application No.<br>PCT/GB2004/002178  | International filing date (day/month/year)<br>19 May 2004 (19.05.2004) | Priority date (day/month/year)<br>20 May 2003 (20.05.2003) |
| International Patent Classification (IPC) or national classification and IPC<br>7 B29C 44/34, 44/10 |  |  |
| Applicant<br>STANELCO RF TECHNOLOGIES LTD   |  |  |

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 bis.1(a).
2. This REPORT consists of a total of 6 sheets, including this cover sheet.  
  
In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Box No. I  | Basis of the report   |
| <input checked="" type="checkbox"/> Box No. II | Priority  |
| <input type="checkbox"/> Box No. III           | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability  |
| <input type="checkbox"/> Box No. IV            | Lack of unity of invention  |
| <input checked="" type="checkbox"/> Box No. V  | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> Box No. VI            | Certain documents cited   |
| <input type="checkbox"/> Box No. VII           | Certain defects in the international application  |
| <input type="checkbox"/> Box No. VIII          | Certain observations on the international application   |

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44bis.3(c) and 93bis.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44bis .2).

|   |  |
|---|--|
|   | Date of issuance of this report<br>25 November 2005 (25.11.2005) |
| The International Bureau of WIPO<br>34, chemin des Colombettes<br>1211 Geneva 20, Switzerland | Authorized officer<br><br>Nora Lindner                           |
| Facsimile No. +41 22 740 14 35  | Telephone No. +41 22 338 89 65                                   |

# PATENT COOPERATION TREATY

*Corrected*

From the  
INTERNATIONAL SEARCHING AUTHORITY

|   |  |   |     |
|---|--|---|-----|
| To:   |  | REC'D 19 NOV 2004   | PCT |
| see form PCT/ISA/220  |  | WIPO  | PCT |
|   |  | WRITTEN OPINION OF THE<br>INTERNATIONAL SEARCHING AUTHORITY<br>(PCT Rule 43bis.1) |     |
|   |  | Date of mailing<br>(day/month/year) see form PCT/ISA/210 (second sheet)           |     |
| Applicant's or agent's file reference<br>see form PCT/ISA/220   |  | FOR FURTHER ACTION<br>See paragraph 2 below                                       |     |
| International application No.<br>PCT/GB2004/002178  | International filing date (day/month/year)<br>19.05.2004 | Priority date (day/month/year)<br>20.05.2003                                      |     |
| International Patent Classification (IPC) or both national classification and IPC<br>B29C44/34, B29C44/10 |  |   |     |
| Applicant<br>STANELCO FIBRE OPTICS LTD  |  |   |     |

**CORRECTED  
VERSION**

- This opinion contains indications relating to the following items:
  - ☒ Box No. I Basis of the opinion
  - ☒ Box No. II Priority
  - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
  - ☐ Box No. IV Lack of unity of invention
  - ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
  - ☐ Box No. VI Certain documents cited
  - ☐ Box No. VII Certain defects in the international application
  - ☐ Box No. VIII Certain observations on the International application


## 2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

- For further details, see notes to Form PCT/ISA/220.

|   |  |   |
|---|--|---|
| Name and mailing address of the ISA:  |  | Authorized Officer                          |
|  European Patent Office - P.B. 5818 Patentlaan 2<br>NL-2280 HV Rijswijk - Pays Bas<br>Tel. +31 70 340 - 2040 Tx: 31 651 epo nl<br>Fax: +31 70 340 - 3016 |  | Pipping, L<br>Telephone No. +31 70 340-3430 |



**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2004/002178

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**Box No. I Basis of the opinion**

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1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material:
    - ☐ in written format
    - ☐ in computer readable form
  - c. time of filing/furnishing:
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in computer readable form.
    - ☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2004/002178

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**Box No. II Priority**

---

1. ☒ The following document has not been furnished:

☒ copy of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(a)).

☐ translation of the earlier application whose priority has been claimed (Rule 43*bis*.1 and 66.7(b)).

Consequently it has not been possible to consider the validity of the priority claim. This opinion has nevertheless been established on the assumption that the relevant date is the claimed priority date.

2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43*bis*.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

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**Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

|                               |             |      |
|-------------------------------|-------------|------|
| Novelty (N)                   | Yes: Claims | 1-29 |
|                               | No: Claims  |      |
| Inventive step (IS)           | Yes: Claims |      |
|                               | No: Claims  | 1-29 |
| Industrial applicability (IA) | Yes: Claims | 1-29 |
|                               | No: Claims  |      |

2. Citations and explanations

see separate sheet

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial  
applicability; citations and explanations supporting such statement**

1. Reference may be made to the following documents:

D1: EP-A-1 096 438 (INT GAME TECH) 2 May 2001 (2001-05-02)

D2: US 2003/017865 A1 (BEAULIEU NICOLE ET AL) 23 January 2003  
(2003-01-23)

- 2.1 Document D1 discloses a gaming apparatus, comprising well-known features to the person skilled in the art, e.g. display unit, value input device, controllers, processors and memories. Document D1 also discloses a plurality of independently operable lights which are capable of displaying visual colors (*cf. column 3, lines 29 - 39*).
- 2.2 Programming the controller in order to generate video images related to a particular game (e.g. poker, blackjack) is not solving any technical problem and is therefore no basis for an inventive step.
- 2.3 Besides the fact that the 'plurality of independently operable lights' is known, they seem to be related to attract players and/or to present game-related information. Just like the programming, this is not solving any technical problem (Rule 5.1(a)(iii) PCT) and is therefore no basis for an inventive step.
- 2.4 Also the implementation of controlling these lights is straightforward (processor, memory, USB) and does not present any unexpected effects or surprising results in order to justify an inventive step.
- 2.5 Therefore the subject matter of independent claim 1 is not inventive as is required by Article 33(3) PCT.
- 3.1 The subject matter of the other independent claims 9, 16 and 22, follow the same reasoning as is presented for independent claim 1.
- 3.2 Therefore, the subject matter of independent claims 9, 16 and 22 is not inventive as is required by Article 33(3) PCT.

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING  
AUTHORITY (SEPARATE SHEET)**

International application No.

PCT/US2004/002178

4. The subject matter of the dependent claims 2 - 8, 10 - 15, 17 - 21 and 23 - 29, is in combination with the claims they refer to, as a whole not inventive as is required by Article 33(3) PCT.

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Corrected

From the  
INTERNATIONAL SEARCHING AUTHORITY

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| International application No.<br>PCT/GB2004/002178  | International filing date (day/month/year)<br>19.05.2004 | Priority date (day/month/year)<br>20.05.2003                                      |     |
| International Patent Classification (IPC) or both national classification and IPC<br>B29C44/34, B29C44/10 |  |   |     |
| Applicant<br>STANELCO FIBRE OPTICS LTD  |  |   |     |

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- For further details, see notes to Form PCT/ISA/220.

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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/US2004/002178

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**Box No. I Basis of the opinion**

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3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
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3. Additional observations, if necessary:

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**Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

---

1. Statement

|                               |             |      |
|-------------------------------|-------------|------|
| Novelty (N)                   | Yes: Claims | 1-29 |
|                               | No: Claims  |      |
| Inventive step (IS)           | Yes: Claims |      |
|                               | No: Claims  | 1-29 |
| Industrial applicability (IA) | Yes: Claims | 1-29 |
|                               | No: Claims  |      |

2. Citations and explanations

see separate sheet

**Re Item V**

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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING  
AUTHORITY (SEPARATE SHEET)**

International application No.

PCT/US2004/002178

4. The subject matter of the dependent claims 2 - 8, 10 - 15, 17 - 21 and 23 - 29, is in combination with the claims they refer to, as a whole not inventive as is required by Article 33(3) PCT.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
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(43) International Publication Date  
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(10) International Publication Number  
**WO 2004/103687 A1**

(51) International Patent Classification<sup>7</sup>: **B29C 67/22,**  
44/10

Hampshire SO53 5RR (GB). **GRIMES, Ryan** [GB/GB];  
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(21) International Application Number:  
PCT/GB2004/002178

(74) Agents: **MANSFIELD, Peter, Turquand et al.**; Accentus  
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kind of national protection available*): AE, AG, AL, AM,  
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CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,  
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,  
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,  
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,  
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,  
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,  
ZW.

(71) Applicant (*for all designated States except US*):  
**STANELCO RF TECHNOLOGIES LTD** [GB/GB];  
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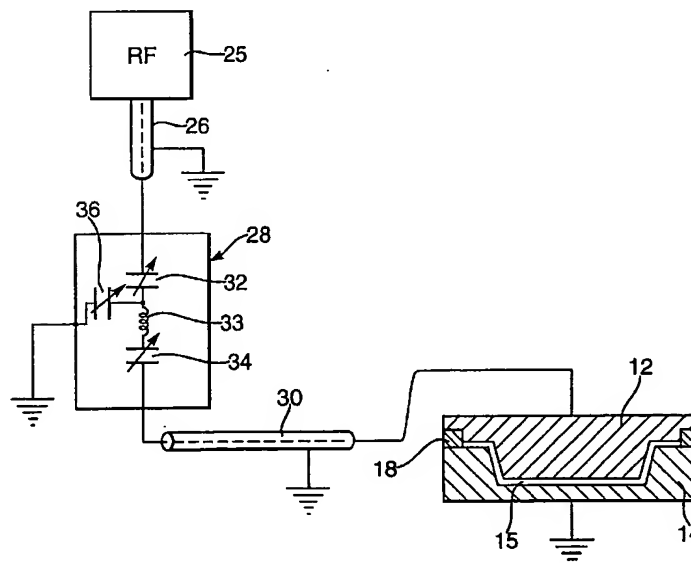
(72) Inventors; and

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(84) Designated States (*unless otherwise indicated, for every  
kind of regional protection available*): ARIPO (BW, GH,  
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,  
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,

[Continued on next page]

(54) Title: MAKING FOAMED BODIES



(57) Abstract: Making foamed bodies by introducing a biodegradable polymer mixture into a mould (10) in which it is heated to form a foam and to fill the mould. The mould is defined between two opposed parts (12, 14) that mate together, and each mould part is of electrically conducting material, and the moulding surfaces are coated with an electrically insulating material (16). Radio-frequency signals are applied (25) between the mould parts (12, 14) so that the polymer mixture is heated by dielectric heating, so a foam tray is formed in less than 15 s. This provides a more rapid cycle time than using heated moulds. The radio frequency signals may be 27.12 MHz, or 40.68 MHz. The polymer may be starch-based.



FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

**Declarations under Rule 4.17:**

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA,

— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations

**Published:**

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

### Making Foamed Bodies

The present invention relates to a method and an apparatus for making foamed bodies; particularly but not  
5 exclusively those made with a biodegradable or water-soluble polymeric material.

In recent years considerable research has gone into the development of biologically degradable polymers, for  
10 example those based on starch. For example US 5 705 536 (Tomka) mentions that a starch foam can be produced by mixing powdered starch with water, and extruding the mixture while converting the water to steam. Tomka indicates that it would be advantageous to use  
15 thermoplastic starch, or polymer blends containing thermoplastic starch, in producing such foamed bodies; such starch contains typically less than 1% by weight of water, and Tomka teaches mixing it with a fibrous material such as ramie fibres containing moisture. The  
20 mixture can be converted into a foam by extrusion at about 200°C. The properties of the resulting product may be modified by adding, for example, plasticising agents and lubricants to the mixture. As explained in US 6 235 815B (Loercks et al) thermoplastic starch can be made  
25 from essentially anhydrous starch that is homogenised in an extrusion process with the addition of a plasticiser such as glycerol or sorbitol, and is melted within a temperature range between 120° and 220°C; thermoplastic starch may be combined with other biodegradable polymers  
30 such as polycaprolactone. Loercks et al teach that a polymer mixture can be made from anhydrous starch mixed directly with a hydrophobic polymer such as an aliphatic polyester, under dry conditions. And US 6 494 704B (Andersen et al) describe a mould press for making  
35 articles such as bowls or trays, the articles being formed between male and female mould halves, and being

- 2 -

made from a starch-based composition that also contains water and may also contain fibres and inorganic fillers, the moulds being heated to between 170° and 220°C. The moulds may be of a metal such as steel or brass, and may  
5 be provided with a nonstick coating of PTFE. Some of the resulting water vapour is allowed to escape through a vent, while some causes foaming expansion of the material in the mould. After a time that is preferably in the range between 30 seconds and 2 minutes the mould halves  
10 can be separated, and the foamed bodies removed. It will be appreciated that a more rapid heating cycle would be beneficial.

According to the present invention there is provided  
15 a method of making a biodegradable foamed body, in which a polymer mixture comprising a biodegradable polymer and water is introduced into a mould, the mould being defined between moulding surfaces of two opposed parts that mate together, wherein each mould part is of electrically  
20 conducting material and each of the moulding surfaces is coated with a layer of electrically insulating material, and wherein radio-frequency signals are applied between the mould parts so that the polymer mixture is heated by dielectric heating, such that the water turns to steam,  
25 so the polymer mixture forms a foam, fills the mould and sets in no more than 15 s.

The radio frequency supply may in principle be at a frequency between 1 MHz and 200 MHz, usually between 10  
30 MHz and 100 MHz, but stringent limits are imposed on any emitted radio waves. In practice therefore the choice of frequency may be more limited. For example the supply frequency may be 27.12 MHz, or 40.68 MHz. This provides a much more rapid way of heating the polymer mixture, so  
35 that the heating, foaming and setting requires no more than 15 seconds, and preferably between 5 and 10 seconds.

The present invention also provides an apparatus for making a foamed body from a polymer mixture, the apparatus including a mould defined between moulding  
5 surfaces of two opposed parts that mate together, wherein each mould part is of electrically conducting material and each of the moulding surfaces is coated with a layer of an electrically insulating material, and means to apply radio-frequency signals between the mould parts  
10 so that polymer mixture between the mould parts is heated by dielectric heating.

The electrically insulating material used to coat the moulding surfaces is preferably one that is not  
15 dielectrically heated, for example PFA (perfluoroalkoxyalkane). Silicone rubber is also suitable, providing good thermal and electrical installation. A surface coating of PTFE is also beneficial, as this makes removal of the body, once it has set, easier. The layer  
20 of electrically insulating material is preferably no more than 2 mm thick.

The polymer mixture contains water, which forms steam on heating; no other foaming agents are used. The  
25 polymer mixture is preferably a starch-based polymer, and may include thermoplastic starch. For good foaming it is important that the pressure becomes high in the die as the steam is generated, so the steam must not be freely vented.

30

The invention will now be further and more particularly described, by way of example only, and with reference to the accompanying drawings in which:

35 Figure 1 shows a cross-sectional view through the upper and lower halves of a mould, when separated;



Figure 2 shows a view corresponding to that of figure 1 during manufacture of a foamed body within the mould; and

5

Figure 3 shows a diagrammatic view of the electrical circuit of the apparatus that includes the mould.

Referring to figures 1 and 2, an apparatus 10 for making trays of a foamed starch-based polymeric material includes upper and lower mould halves, 12 and 14 respectively, which mate together to leave a narrow cavity 15 between them in which the tray is to be formed. Each mould half 12 and 14 is of brass, and each has a coating 16 of PFA electrical insulator over the entire surface facing the cavity 15. With the two halves 12 and 14 separated as shown in figure 1, polymeric material is introduced into the lower half 14, and the upper half 12 is then lowered into position. A peripheral ridge 18 of electrically-insulating alumina on the lower half 14 has a sloping inner face, and contacts a correspondingly-shaped peripheral rim on the upper half 12 such that the cavity 15 is of uniform thickness 2.5 mm and the halves 12 and 14 of the mould are held accurately aligned. Radio frequency signals are then applied between the two halves 12 and 14, which act as electrodes. The alumina ridge 18 ensures that the radio-frequency signals are concentrated across the cavity 15. The polymeric material becomes hot, and water in the polymeric mixture boils, so that the material becomes a foam filling the entire cavity 15.

Immediately adjacent to the peripheral ridge 18, the upper mould half 12 defines a peripheral recess 20 which communicates through a narrow slot with the mould cavity 15. There are several narrow ducts 22 (only one of which

- 5 -

is shown) extending through the upper mould half 12 from this peripheral recess 20. Steam from the hot polymeric mixture can escape into the peripheral recess 20, and hence escape through the narrow ducts 22, but the ducts  
5 22 restrict the flow of the steam, so the pressure in the cavity 15 rapidly rises as the polymer foams up. For example it may rise to above 10 atmospheres. This corresponds to the steam and polymer mixture reaching a temperature above about 185°C. After about 8 seconds the  
10 polymeric mixture has formed a self-supporting tray, and the two halves are again separated, and the tray removed.

It will be appreciated that such an apparatus may be used to make a wide range of different products, by using  
15 appropriately-shaped moulds, and that the products may be of any desired shape. For example it may be used to make multi-compartment trays, circular or square plates or bowls, or cups, or a clam-shell container formed of two shells hinged together along a straight edge. It will  
20 also be appreciated that, although the apparatus has been shown as comprising only a single mould, there might instead be several moulds forming an array, all the moulds being connected to a common radio frequency supply.

25

Referring now to figure 3, the electrical circuit is shown diagrammatically. A radio-frequency signal generator 25, which is a solid-state device, supplies the radio frequency signal via a coaxial cable 26 to a  
30 matching network 28, from which the signal is supplied via a coaxial cable 30 to the upper mould half 12, the lower mould half 14 being earthed. The matching network 28 is shown in more detail. The signal passes through a variable capacitor 32, an inductor 33, and a variable  
35 capacitor 34, and so to the cable 30. A monitoring circuit (not shown) monitors the radio frequency current

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and voltage, and adjusts the values of the variable capacitors 32 and 34 so that the impedance presented to the generator 25 remains at a constant value such as 50 ohms. The junction between the capacitor 32 and the inductor 34 is connected through a capacitor 36 to earth potential, and the effective capacitance of this capacitor 36 can be adjusted. This has the effect of finely adjusting the radio frequency voltage applied between the live electrode (the upper mould half 12) and the opposed, earthed electrode (the lower mould half 14), and the RF current supplied. It thus controls the power that is actually supplied between the mould halves 12 and 14.

The nature of the polymer is not critical to the present invention, although the polymer must be biodegradable, and is preferably at least partly starch-based. The polymer may include thermoplastic starch, but because this may not contain significant quantities of water it is necessary to include another ingredient that provides the requisite water in order to form the foam. A benefit of using thermoplastic starch is that the resulting foamed body, although biodegradable, does not readily dissolve in water. Alternatively the polymer may comprise starch granules at least partly gelatinised by reacting with water. The mixture may contain salt (e.g. NaCl), to alter its electrical conductivity, and may also contain a plasticiser such as sorbitol. The polymeric mixture may contain other polymeric materials, and may also contain reinforcing fibres, such as cellulose organic fibres such as those from hemp or cotton or other plants. Although the fibres strengthen the resulting foamed products, the concentration of fibres preferably does not exceed about 50%, and is preferably no more than 25% of the total weight. It will also be appreciated that the polymeric mixture may be introduced into the

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mould in the form of a film, granules, pellets, a pre-form or a pasty mixture, and may be of a wet appearance.

For example, foamed starch trays have been made by  
5 mixing cornstarch (cornflour) and water in equal  
quantities by mass. This mixture was then introduced  
into a mould as described above, but with the cavity 15  
being of thickness 2 mm and of diameter 110 mm. When  
radio-frequency energy was applied, the starch mixture  
10 foamed up to produce a foam tray filling the cavity. The  
volume increase is greater than three times.

It will be appreciated that the apparatus may be  
modified in various ways, for example the thickness of  
15 the coating 16 of electrical insulator may be between 20  
and 50  $\mu\text{m}$ . And as mentioned above, the mould shape will  
depend upon the shape of the desired product. When  
making a product that includes a hinge (such as a clam-  
shell container), the hinge may be provided by a strip of  
20 a polymeric non-foaming material (for example a strip of  
hydroxypropylmethylcellulose) placed in the mould along  
with the mixture of which forms the foam, so that the  
hinge strip becomes integral with the foam parts on each  
side of the hinge.

Claims

1. A method of making a biodegradable foamed body, in  
which a polymer mixture comprising a biodegradable  
5 polymer and water is introduced into a mould, the mould  
being defined between moulding surfaces of two opposed  
parts that mate together, wherein each mould part is of  
electrically conducting material and each of the moulding  
surfaces is coated with a layer of an electrically  
10 insulating material, and wherein radio-frequency signals  
are applied between the mould parts so that the polymer  
mixture is heated by dielectric heating, such that the  
water turns to steam, so the polymer mixture forms a  
foam, fills the mould and sets in no more than 15 s.  
15
2. A method as claimed in claim 1 wherein the radio-  
frequency signals are applied such that the polymer  
mixture forms a foam, fills the mould and sets in less  
than 10 s.  
20
3. A method as claimed in claim 1 or claim 2 wherein the  
radio-frequency signals are applied at a frequency  
between 20 MHz and 50 MHz.
- 25 4. A method as claimed in claim 3 wherein the polymer  
mixture is at least in part starch-based.
5. A method as claimed in any one of the preceding  
claims wherein the pressure in the mould rises to above  
30 10 atmospheres during the foaming process.
6. An apparatus for making a foamed body from a polymer  
mixture, the apparatus including a mould defined between  
moulding surfaces of two opposed parts that mate  
35 together, wherein each mould part is of electrically  
conducting material and is coated with a layer of an

electrically insulating material, and means to apply radio-frequency signals between the mould parts so that polymer mixture between the mould parts is heated by dielectric heating.

5

7. An apparatus as claimed in claim 6 wherein the electrically insulating material used to coat the moulding surfaces is one that is not dielectrically heated.

10

8. An apparatus as claimed in claim 6 or claim 7 wherein, when the mould parts are together, they are held apart by an electrical insulator that is thicker than the gap defining the mould.

15

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Fig.1.

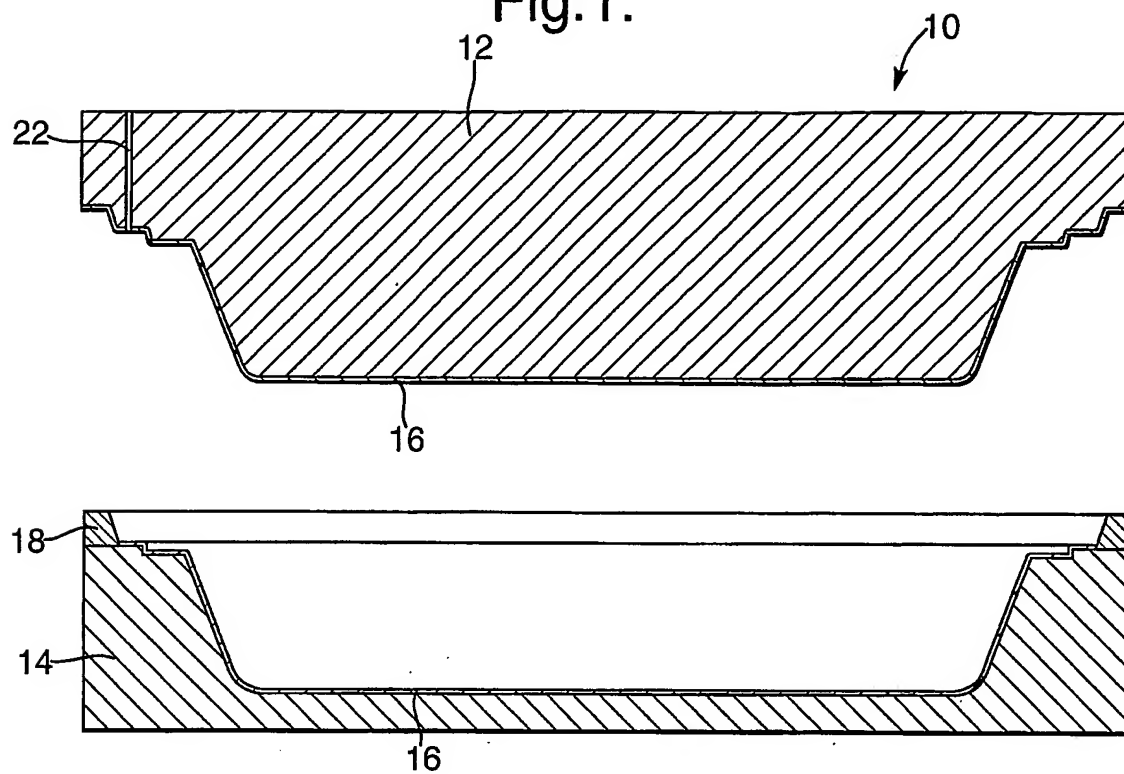


Fig.2.

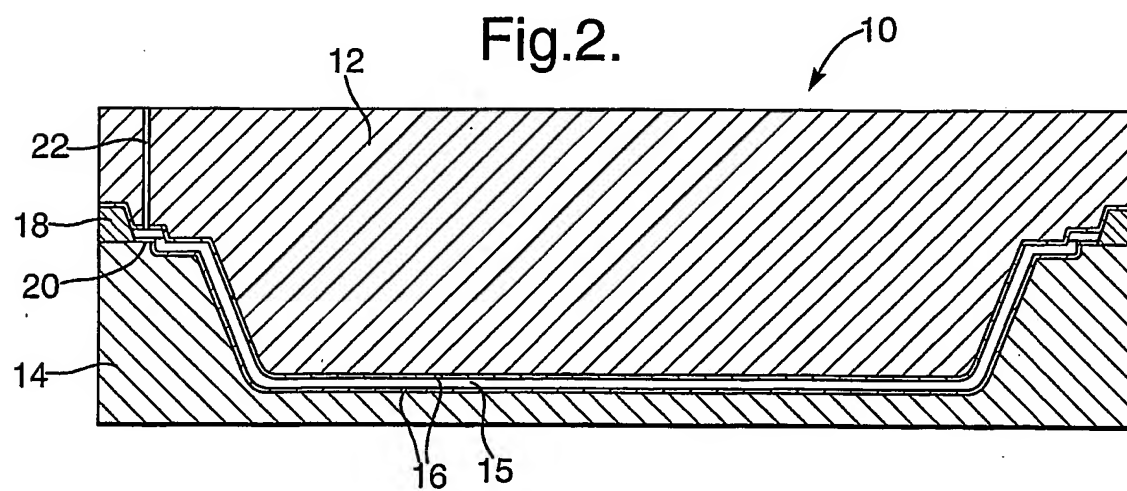
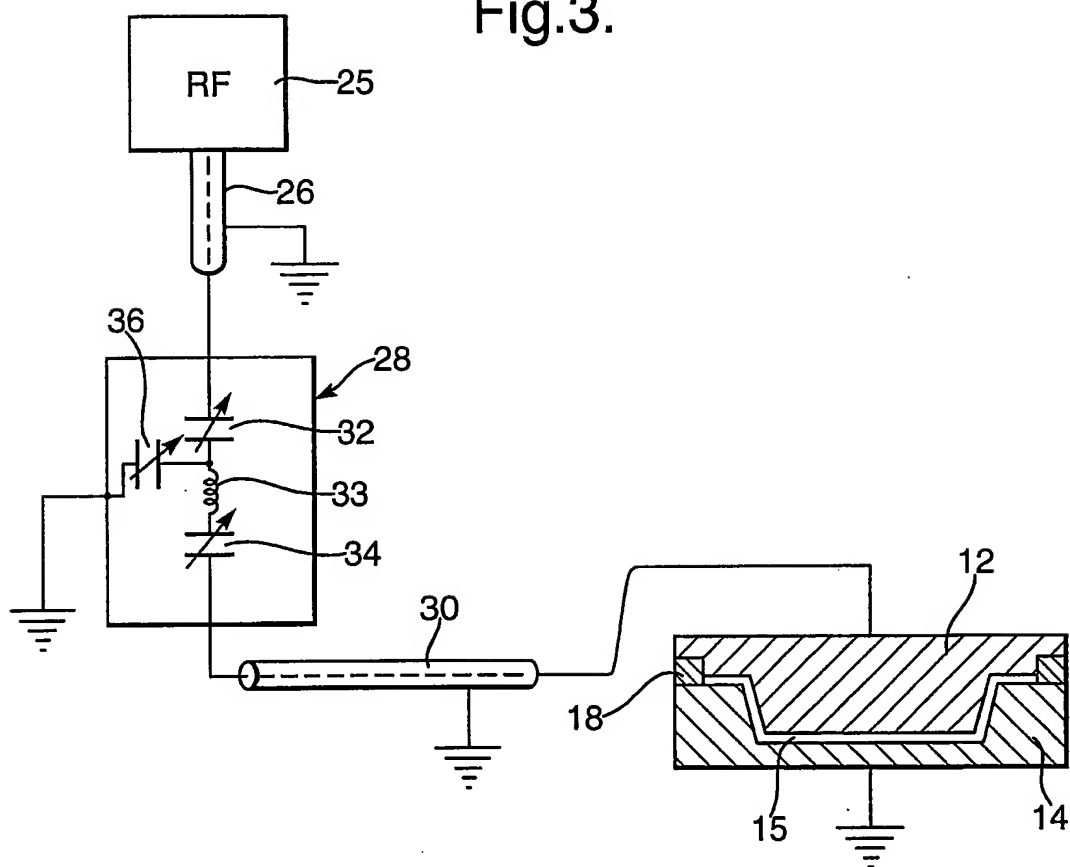


Fig.3.





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Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages   | Relevant to claim No. |
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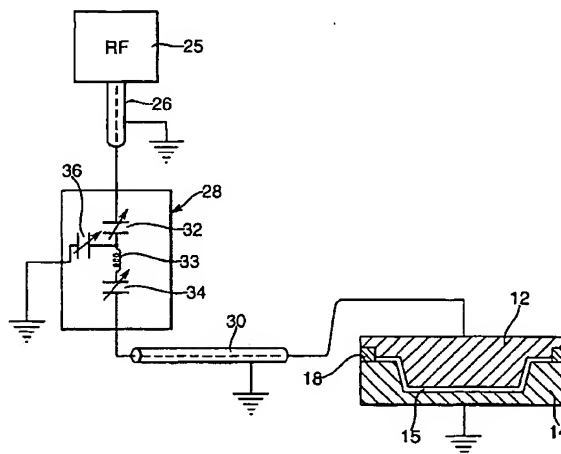
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(54) Title: MAKING FOAMED BODIES



(57) Abstract: Making foamed bodies by introducing a biodegradable polymer mixture into a mould (10) in which it is heated to form a foam and to fill the mould. The mould is defined between two opposed parts (12, 14) that mate together, and each mould part is of electrically conducting material, and the moulding surfaces are coated with an electrically insulating material (16). Radio-frequency signals are applied (25) between the mould parts (12, 14) so that the polymer mixture is heated by dielectric heating, so a foam tray is formed in less than 15 s. This provides a more rapid cycle time than using heated moulds. The radio frequency signals may be 27.12 MHz, or 40.68 MHz. The polymer may be starch-based.



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